
ON THEIR OWN

Students' Responses to Open-Ended Questions
In

Math, Reading, Science, Social Studies

Results of the 1990 Assessment

Massachusetts Department of Education

Massachusetts Educational Assessment Program

MASS ED 21.2: On 1/990/011



9.2/218

ON THEIR OWN

Students' Responses to Open-Ended Questions in Science

Grades 4 & 8

Different birds live in different areas or habitats (such as woods, lakes marshes or open areas). They eat different foods (such as fish, seeds, insects, or small animals). Birds with webbed feet swim well and live on or near water. Hummingbirds have long, thin beaks which they use to draw nectar from flowers.

Look at the pictures of the birds and notice how they are different. What do you think is the main habitat and the main food of each? Write your answers in the spaces to the right of each picture. Also explain why you chose the answer you did for each bird.

The percentage of student responses and appropriate examples are listed under each of the categories below.



Correct Answers

Gr4 Gr8

*** 9% 14% Relates appropriate characteristics to BOTH habitat and food. (Can be the same or different characteristics but must mention both habitat and food.).

Major Concepts/Abilities Tested

Life science
Adaptation
Observation skills
Functions of characteristics
Diversity of life
Habitats

"I think the reason this bird lives in a high branch is because he/she has sharp nails that grip into the tree and the bird's feet are shaped that way. I think the bird eats small rodents because it can swoop down and grab it with its sharp claws." (grade 4)

**** 13% 25% Relates 1 or more physical characteristics to EITHER habitat or food.**

"This bird has long nails to catch the animals and it's beak is tilted inward to eat the animals better." (grade 8)

(Although the student mentions two characteristics, they both relate to food.)

*** 6% 2% Relates 1 or more physical characteristics to habitat and/or food but relationship is VAGUE.**

"He eats rodents because look at the feet they were made to grip and lock. (grade 8)"

(Although there is a suggestion that the claws are for catching and grasping rodents, it has not been made very clear.)

******* *very good answer*

****** *good answer*

***** *minimally correct answer*

4% 4% Mentions characteristics but does not relate.

"This owl has very long, sharp, powerful claws and legs. The wings are powerful too. (grade 8)"

3% 5% Relates physical characteristics not evident from picture to habitat and/or food.

"This bird is dark and has very dull colors. It is its camouflage and when a victim comes along, the mouse probably scatters and the bird dives and catches him." (grade 8)

3% 5% Uses "because it looks like" as a reason.

"His nose looks like he would eat insects. To me he looks like a woods kind of bird." (grade 4)

7% 4% Other incorrect response.

"He eats caterpillars because it shows him sitting on a tree and trees usually grow in the woods and caterpillars crawl on trees." (grade 4)

3% 8% Blank

Incorrect Answers

51% 35% Gives FACTS (not necessarily correct) about bird shown (prior knowledge).

"Owls live in the woods and come out at night for food and such. I read a book about on owls and found out about them. (grade 4)"

Comments/Owl

It's clear from the results that students learn a lot about owls and feel compelled to share their knowledge. The owl is the only bird of the four given that elicited such a large number of students responding in this way. It could be that the owl is so interesting

and unique and such a common cultural symbol that students know more discrete facts about them. It is possible that students could have incorporated prior knowledge into a correct response. Many students did. For example, if a student knows that owls eat mice, then he or she may determine that the claws are large for tearing mice simply from knowing what owls eat and observing the picture of the owl. Fewer students left this bird blank, indicating that they have some knowledge about owls. However, it seems as though those blanks were picked up in the prior knowledge category.



Correct Answers

Gr4 Gr8

- *** 5% 13% **Relates appropriate characteristics to BOTH habitat and food. (Can be the same or different characteristics but must mention both habitat and food.)**

"The beak looks like it digs worms from the ground because of the pointed end and the feet are somewhat webbed and looks like it could walk on mud of marshes." (grade 8)

(Although the bird did not have webbed feet, the picture could be interpreted as such. The student received full credit for the response because he/she was able to make the appropriate inferences. We were not looking for correctness of response regarding what the actual bird ate and where it lived; we were assessing students' ability to

observe a characteristic and make a judgement based on that characteristic.)

- ** 17% 24% **Relates 1 or more physical characteristics to EITHER habitat or food.**

"They have pointed beaks to get seeds from the ground." (grade 4)

- * 9% 3% **Relates 1 or more physical characteristics to habitat and/or food but relationship is VAGUE.**

"This bird has webbed feet and there are many insects near marshes." (grade 8)

(There is no explicit relationship between webbed feet and insects; the inference being that a bird with webbed feet would live near the water, and because insects live near the water the bird would eat insects.)

- *** *very good answer*
 ** *good answer*
 * *minimally correct answer*

Incorrect Answers

- 28% 21% **Gives FACTS (not necessarily correct) about bird shown (prior knowledge).**

"This bird is a robin and usually found in the wide open area; for example, your yard." (grade 8)

5% 6% **Mentions characteristics but does not relate.**

"He doesn't have claws or a short fat beak. Instead it has a long skinny beak with webbed feet." (grade 4)

8% 9% **Relates physical characteristics not evident from picture to habitat and/or food.**

"I'd say it's main habitat is in a tree because this is a rather small bird and needs a warm and safe place for itself and its babies. I'd say it's main food is worms or insects because it is a small bird and would not be able to kill or swallow mice like an owl." (grade 4)

(Although it may be prior knowledge that leads the student to believe that the bird is small, the picture does not indicate the bird's size. In the pictures, the largest bird, the heron, actually appears to be the smallest. When dealing with size, there are some size qualities that we do accept, for example, students' responses mentioning the heron's long beak are accepted as correct because, in relation to the rest of the heron's body, the beak is very long.)

8% 8% **Uses "because it looks like" as a reason.**

"This bird looks like it could be seen anywhere and live comfortably at any of the locations. It also looks like it eats worms and other insects." (grade 8)

13% 5% **Other incorrect response.**

"This bird has eyes on each side of his head so he or she can see things coming toward him. That is for protection." (grade 4)

7% 11% **Blank**

Comments/Robin

About the same number of students answered this question correctly as did the previous question. Although the robin is as familiar to most students as the owl, fewer students answered in the category of prior knowledge. It could be that, without seeing the colors of the birds, students did not recognize the robin. There may have been some confusion for some students who recognized the robin, but then saw the webbed feet and could not adjust their prior knowledge of robins to what they saw in the picture.



Correct Answers

Gr4 Gr8

*** 8% 17% **Relates appropriate characteristics to BOTH habitat and food. (Can be the same or different characteristics but must mention both habitat and food.)**

"It probably lives in tree trunks because it can dig its claws into the side of the tree to build its nest. Also, I think it eats bugs because it has a long beak that it can put into a tree and pull out bugs." (grade 4)

**** 17% 24% Relates 1 or more physical characteristics to EITHER habitat or food.**

“This bird’s long beak looks good for reaching into the home of insects because it’s long and narrow.” (grade 4)

*** 7% 3% Relates 1 or more physical characteristics to habitat and/or food but relationship is VAGUE.**

“The woodpecker likes to carve out wood from the trees with its sharp beak and finds and eats the insects.” (grade 8)

(The student response is fairly clear, but the relationship between the characteristic and the food is very vague, bordering on incorrect.)

*** *very good answer*

** *good answer*

* *minimally correct answer*

7% 5% Relates physical characteristics not evident from picture to habitat and/or food.

“Since I have not seen a bird like this around, I suspect it hides itself in someplace where it can’t be seen easily—the woods. It is a smallish bird so I would think it eats insects.” (grade 8)

7% 8% Uses “because it looks like” as a reason.

“He looks like he is too small to eat meat.” (grade 4)

10% 5% Other incorrect response.

“This bird looks for a place where he can see more clearly.” (grade 8)

8% 13% Blank

Incorrect Answers

29% 20% Gives FACTS (not necessarily correct) about bird shown (prior knowledge).

“The woodpecker pecks on trees in the woods to get insects out of the trees.”

(This answer is very similar to the third response above, but there is no mention of the beak or its qualities.)

8% 6% Mentions characteristics but does not relate.

“He has sharp claws and a pointed beak.” (grade 8)

Comments/Woodpecker

Student responses here are very similar to those of the robin. It appears that the more usual looking the bird, the less students have to say about them. Compare the results of the robin and woodpecker with those of the heron which follow.



Correct Answers

Gr4 Gr8

- *** 14% 34% **Relates appropriate characteristics to BOTH habitat and food. (Can be the same or different characteristics but must mention both habitat and food.)**

"The long legs can hold him above the marshes and the long pointed beak is ideal for stabbing fish." (grade 8)

- ** 20% 22% **Relates 1 or more physical characteristics to EITHER habitat or food.**

"This bird has long legs, a long neck and a long beak that could allow him to walk in the water and dunk his head into the water to get fish." (grade 8)

(Although three separate characteristics are mentioned, the student only discusses them in relation to food.)

- * 7% 3% **Relates 1 or more physical characteristics to habitat and/or food but relationship is VAGUE.**

"They have webbed feet and if they live near or on water then they are most likely to eat fish." (grade 4)

(Here there is an inference of the relationship between webbed feet and fish as food although it is not well elaborated.)

"Because he has long legs you would probably see him near the water so he would probably eat fish." (grade 8)

(There is no indication as to why long legs would make the bird a water bird.)

- *** *very good answer*
 ** *good answer*
 * *minimally correct answer*

Incorrect Answers

- 29% 16% **Gives FACTS (not necessarily correct) about bird shown (prior knowledge).**

"It's a flamingo and flamingoes live in marshlands and marshlands are mostly bugs and fish." (grade 4)

- 8% 5% **Mentions characteristics but does not relate.**

"It has long webbed feet, a long, sharp beak and a long neck." (grade 8)

- 5% 1% **Relates physical characteristics not evident from picture to habitat and/or food.**

"He is big and is easily able to hunt small animals." (grade 8)

5% 2% Uses “because it looks like” as a reason.

“This bird looks like a bird from the jungle who eats fish.” (grade 4)

6% 4% Other incorrect response.

“This is the ancestor of the swan.” (grade 8)

8% 13% Blank

Comments/Heron

At both grade levels, students were most successful when writing about the heron. Approximately ten percent more of the fourth graders and twenty percent more of the eighth graders were able to answer this question successfully than were able to answer the other birds given; owl, robin and woodpecker. What is it then about the heron that lends itself to better responses? One answer may be that with its long legs, neck and beak, the characteristics are far more exaggerated so students are able to more easily make connections about adaptations. Another might be that the bird is far more exotic and therefore less familiar to New England students. The owl carries cultural baggage, the robin and woodpeckers are both fairly mundane, but the heron is not an everyday bird.

Comments

The responses to this question suggest that although many students are able to make inferences based on observations, a large number have problems with this type of thinking. It is a habit of mind rather than a piece of discrete information. One way of opening students to this type of thinking would be to begin with a question rather than with a fact. For example, these questions, “Why does the owl have such strong, sharp claws?” and “How do the owls’ claws affect how they survive?” open the door to a more unified and systematic way of thinking and looking at something. By connecting the structure of the animal with its environment and diet, we can show the interrelatedness of all species. Students will eventually come around to the desired conclusion, but it will be through a series of observations and discoveries rather than memorization and recitation. This type of subject leads to a discussion of adaptation and how, over the generations, species carried characteristics that enabled them to survive.

Another way of getting students to examine function and form is to ask them to draw a bird that lives in the water and eats fish, as opposed to a bird that lives near the water and eats plankton. This method would direct students to forms of adaptation.

ON THEIR OWN

Students' Responses to Open-Ended Questions in Science

Grade 4

Every time Tom boils water to make spaghetti, the insides of his kitchen windows get wet. Explain how this happens.

Major Concepts/Abilities Tested

Physical science

States of matter

Transformation of water

The percentage of student responses and appropriate examples are listed under each of the categories below.

Correct Answers

*** 8% Discusses water **EVAPORATING** and **CONDENSING** (may or may not actually use terms); explanation clear and completely correct.

"The water boils and turns to steam. Steam is a gas called water vapor. Water vapor gets on the windows. The windows are cold so the water cools off causing the water to condense or change into little droplets of water which make the windows wet."

** 13% Discusses water **EVAPORATING** and **CONDENSING** (with or without using terms); explanation somewhat vague or lacking; may contain some inaccurate statements.

"Before the water boils, it's just water. But when it boils it makes steam. The steam is made by little drops of water. When the steam cools, the water drops go back to water and makes the windows wet because the steam was in the air."



Massachusetts
Educational
Assessment
Program

Massachusetts Department of Education

April 1991

In the spring of 1990 over 9,000 fourth, eighth, and twelfth grade students were assessed using open-ended mathematical, scientific, social studies, and reading concepts. This series of reports describes and discusses the results of these assessments. Prepared by Brenda Thomas and Elizabeth Badger.

(Although the student displayed some correct notions with the mention of heating and cooling, the student does not define steam as a gas, but rather as smaller drops of water. There is not enough sense of transformation from liquid to gas and back to liquid states to merit the first classification.)

- * **54% Discusses ONLY EVAPORATION or production of STEAM and not transformation back into liquid.**

“The steam rises up and covers the window with water because the steam cannot get out.”

“When you boil water for a period of time, steam starts to rise. When the steam rises and its near a window, the window will start to get damp.”

“Every time Tom boils water to make spaghetti, the insides of his kitchen windows get wet. This is because the water evaporates and clings to the window.”

Students whose answers fell in this category appear to have a general sense of the relationship between the boiling water and wet window, but don't understand the transition so they simply say the steam sticks to the window.

- *** *very good answer*
- ** *good answer*
- * *minimally correct answer*

Incorrect Answers

- 11% Suggests that the HEAT is creating the moisture.**

“Because the steam from the water is so hot when it goes up in the air it brings water along and it hits the window and the window becomes wet.”

- 15% Other incorrect response.**

- 1% Blank**

Comments

This question attempts to find out what children really understand about the transformation of matter. Can they do more than offer the terms *evaporation* and *condensation* and explain that although matter changes state, it remains the same substance?

We did not expect students to explain this on a molecular level although a few did attempt it successfully. More than half were able to adequately explain evaporation, yet only 21% were able to explain evaporation and condensation. Although students appear to be aware that steam is a gaseous state of water, they do not seem to understand the converse, that steam can revert back to water. Some described steam not as a gas but as tiny droplets of water floating through the air. Often students knew the terms *evaporation* and *condensation*, but were not able to elaborate.

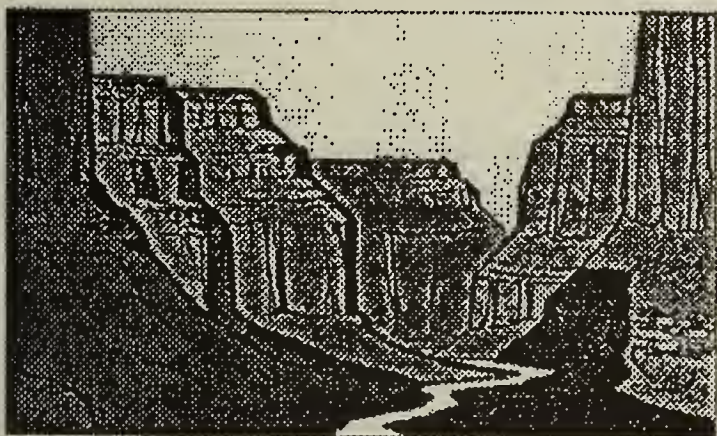
Student responses to this question point to two potential difficulties that are not unrelated. The first is that students are not clear on the concept of transformation of matter. At the early grades, this is the type of science that students can easily understand if it is taught in a concrete manner; i.e. if students are allowed to do experiments, make observations, and draw conclusions about the states of water.

The second problem is that students use of the correct word for a concept may mask their misconceptions. This can happen when the technical vocabulary is introduced before the student has some understanding of the concept. If a teacher accepts the answer “evaporation” as an explanation of what happens to water when it is heated without learning what evaporation means to that student, then it is possible that the student and teacher mean different things. The longer these types of misconceptions go uncorrected, the more difficult it becomes to amend them. Some of the current research about prior knowledge indicates that a demonstration of the concept along with a reading in a text is successful in correcting misconceptions.

ON THEIR OWN

Students' Responses to Open-Ended Questions in Science

Grade 4



How could you show a classmate how water can create a canyon?

Major Concepts/Abilities Tested

Earth science
Concept of erosion
Modelling
Reasonableness of response

The percentage of student responses and appropriate examples are listed under each of the categories below.

Correct Answers

*** 5% Subjects dirt, sand, rock or other material to **MOVING** water passing through the material over a **PERIOD OF TIME**.

"I would get a big long plastic bowl or something like that and stack dirt up to the sides and run water through it constantly. After a long period of time, check it and see what happens. Hopefully it would work out right."

"You could take a rough rock and somehow get water to run onto it without wasting *too* much water until it gradually got smoother and smoother."

** 11% Subjects dirt/sand to **MOVING** water (accurate simulation of the effects of erosion—not necessarily over a long period of time).

"You can take a jug of water, put piles of dirt on a platform and pour the water on the platform and it will make like a tunnel in between the piles of dirt."

(The difference between the first two correct answer categories is that the first accounts for some length of time to demonstrate erosion and the second uses a material such as sand that is not compacted, so it will show the effects of erosion without a repeated stream of water. Both were considered to be accurate.)

**** 16% Subjects material to moving water—not as good a simulation as above.**

“I would take loose sand and pour water through it. The water would make small canyons wherever it went.”

(The first three responses all suggest that the water flows through the material.)

*** 12% Instructional devices (static model, pictures, report, video to illustrate rather than to demonstrate).**

“You could show him pictures of one mountain over the years. You could show him how water erodes the mountain each year.”

*** *very good response*

* *good response*

* *minimally correct response*

Incorrect Answers

(Generally, incorrect answers did not consider the flow of water.)

20% Mixes dirt/sand/rock with water implies standing water when poured and/or compacting of the dirt.

“If you took a bowl, soil and water you could fill the whole bowl full of soil and then pour water down the

middle. In the middle it wouldn't be so much soil. It would have been pushed to the sides.”

7% Response implies dissolving something in water.

“By getting a bucket of water and some paper crumpled up with a rock in it. Put the paper in the water and it will start to rip.”

26% Other incorrect response.

4% Blank

Comments

Many students (20%) did not take into account the idea of a flow of water wearing away the surface. They tended to suggest a more stagnant representation such as putting some sand in a bucket and running water into the bucket. In order to be perfectly accurate, there had to be a means of escape for the water.

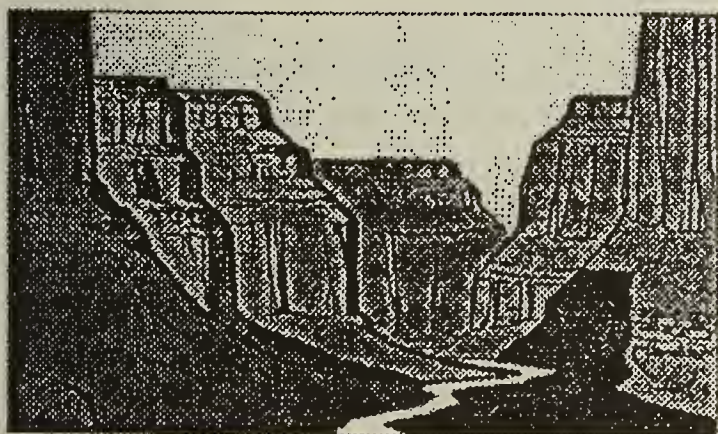
A model makes the abstract concrete and the inaccessible accessible. Students' models can indicate their levels of understanding. Those who may give a correct written description of erosion may show their basic lack of understanding of the concept by suggesting that water be placed in a bucket. Some students suggested filming erosion, indicating a weak concept of time; others suggested visiting the same place year after year, indicating a sense of time, but not the idea of reasonableness of response.

This type of question lends itself very easily to becoming an in-class experiment. With students working cooperatively, the combined knowledge and skills would probably generate better results than those shown here.

ON THEIR OWN

Students' Responses to Open-Ended Questions in Science

Grade 4



People claim that the canyon shown in the picture above was created by water. Explain how water could do this.

Major Concepts/Abilities Tested

Earth science

Formation of land

Changes in the earth's surface

The percentage of student responses and appropriate examples are listed under each of the categories below.

Correct Answers

*** 16% Discusses erosion with accurate elaboration (e.g. moving water, long time, etc.).

"A long time ago, the land had lots of rivers running through it, and it began to wear out. It caused erosions and after many years, it formed this."

** 22% Erosion; some elaboration, no inaccuracies.

"Water could cause erosion. Erosion is the wearing away of the earth's surface by wind or water."

(Here the student does not mention the length of time involved. "Wearing away" might be construed as implying a length of time, but we did not feel we could infer that from this answer.)

"Water could have created the canyon shown above because if you think about it,

if you have a lot of sand or dirt, then rushing water comes through, sooner or later some of the sand will disappear.”

(This answer does address the time issue to some extent, but implies that it is the strong force of water on loose soil that causes erosion rather than the constant flow of water on packed soil.)

*** 21% Erosion; no elaboration or some inaccuracies.**

“The force and power of the water can break off pieces of the earth. Then after many days it forms a canyon.”

*** *very good response*

* *good response*

* *minimally correct response*

Incorrect Answers

6% Rain washes away rock.

“Water could have done this by raining a lot. Say there was a rainstorm, if the rain came down real fast it could knock off pieces of rock and it would chip more off every time it rained there.

6% Sand/material is deposited to form walls/mountains.

There might have been a big erosion a long time ago and it probably carried the rock and stone in it to this place and all the rock and stone piled up.”

6% Answer implying that the water has drained away, leaving the canyon i.e., there used to be a lot more water.

“I think that there was a flood and that water came running down the canyon and the water dried up and it formed the shape of the canyons.

7% Discusses other natural phenomenon e.g., earthquakes, glaciers, volcanoes.

The canyons were once part of all land. One day an earthquake took place which cracked the land, Water came in and the pressure of it formed the canyon.”

16% Other incorrect response.

2% Blank

Comments

About 60% of the students were able to answer with some degree of correctness. Students demonstrated many misconceptions of how water forms a canyon: water deposits on the rock to form the canyon walls; the force of water rather than its steady flow causes the canyon; the canyon was formed instantaneously as the result of an earthquake or flood. The idea of great sudden violence seems to override the idea of gradually wearing away the surface.

Twenty percent answered “erosion,” but did not define it or defined it incorrectly. Less emphasis on the word erosion and more emphasis on the concept it represents would allow students to articulate the concept in their own vocabularies. If students are clear on the concept, then the introduction of the scientific vocabulary can only enhance their understanding; if they are not clear, then the introduction of that vocabulary tends to mask misunderstanding with an appropriate word.

Many students have a problem with the concept of time, especially when trying to define a long period of time. They are not able to distinguish between one hundred years, one thousand years, and one million years. So students who define erosion as running water wearing down rock over a long period of time may not be entirely correct, depending on their definition of a long time.

ON THEIR OWN

Students' Responses to Open-Ended Questions in Math

Grade 4

Write a story problem that could be solved by the computation below.

$$\begin{array}{r} 12 \\ \times 4 \\ \hline 48 \end{array}$$

Major Concepts/Abilities Tested

Numeration: concept of multiplication

Ability to recognize the function of the multiplication algorithm in an everyday context

Other Concepts/Abilities Tested

Communication of mathematical ideas

Understanding of mathematical language and symbols

The percentage of student responses and appropriate examples are listed under each of the categories below.

Correct Answers

**** 52% Appropriate word problem suggesting multiplication.**

"Tommy is going to buy four rugs. Each rug costs \$12.00. How much money did he spend in all?"

**** 2% Appropriate word problem suggesting repeated addition.**

"Meghan has 12 stamps. Jon gives Meghan 12 more stamps. Then Karen and Tom each given Meghan 12 stamps apiece. Meghan wants to know how many stamps she has. What should she do?"

**** 3% Gives problem the answer of which is a factor, not a product.**

"I had 48 apples. I divided them equally among my 12 friends. How many did they each get? They each got 4 apples."

***9% Weak problem situation.**

"Tara took 4 cookies, 12 times in a row on Monday. How many cookies did Tara take in all?"

**** good answer**

*** acceptable answer**

Incorrect Answer

7% Explains procedure for multiplying 4×12 .

"First we take the two from the twelve and times it eight and that = 8. And then we take the 1 and times 4 and that = 4. And then you put it in front of the eight and that = 48."

"The problem is 12 times 4. You could add 12 4 times. The answer is 48."

5% Problem is vague or unclear.

"In 2 days there are 48 hours. In one day there are 24 hours. In one half of a day, there are 12 hours. You know that in two days there are 48 hours. You know that because $12 \times 4 = 48$."

4% Gives addition problem.

"12 students went to their class. 4 more kids went to their class late. How many kids went to class? $12 \times 4 = 48$."

"Josh had 12 stamps. Mike gave Josh 4 stamps. How many did Josh have now. Hint—multiplication."

2% Gives problem in which there are "4 times as many."

"On Sunday afternoon there were going to be football try-outs at 12:00 p.m. At 11:45 a.m. 12 kids showed up, but between 11:45 a.m. and 12:50 a.m. 4 times as many kids showed up than at 11:45 a.m. How many kids showed up in all?"

20% Other.

"Carrie had 12 baseball cards. Maudie had 36. How many baseball cards in all?"

"A man put 12 cans of tomatoes on the shelf. By the end of the day there were only 4 cans of tomatoes left on the shelf. How many cans were on the shelf in the beginning?"

2% Blank

Comments

Over half the students were able to give an appropriate and convincing problem for the computation given. The other students were less sure about the kinds of situations in which multiplication would be useful. Some students (as illustrated above) appeared to confuse multiplication with addition. Others used phrases such as "four times as many" without thinking about the language itself. Although it is true that 48 is "four times as many" as 12, this phrase does not signify the same thing in a problem.

Write one story problem that takes 2 steps to solve.
The steps must use the computations shown.

$$\begin{array}{r} 35 \\ \times 2 \\ \hline 70 \end{array} \qquad \begin{array}{r} 70 \\ + 25 \\ \hline 95 \end{array}$$

Correct Answer

**** 35% Appropriate multi-step problem.**

"Each of the king's light infantry had 2 weapons, a handaxe, and a short sword. The king has 35 light infantry. How many weapons do all the light infantry have together?"

Each of the king's 25 heavy infantry have 1 weapon, a battle axe. The king's army has only heavy and light infantry, no knights or archers or anything else. How many weapons does the king's army wield?"

"Jill had 35 stamps on each page. There were two pages. Then she bought 25 more stamps. How many stamps does Jill have?"

*** 3% Appropriate multi-step problem using different numbers from the ones given.**

"Diana has 20 oranges in one box. She has two boxes. She also has 15 oranges in another box. How many oranges does she have in all?"

*** 5% Appropriate multi-step problem, but omits question or asks inappropriate question.**

"Tim had a dollar. He bought 2 things for \$.35. Then he bought something for \$.25. Does he have enough money?"

"Robyn and Jeff had \$35.00 each. David had \$25.00 more than them put together."

**** good answer**

*** acceptable answer**

Incorrect Answer

10% Writes computation in words or explains how to solve problems.

"Well, $35 \times 2 = 70$. How? Well, $5 \times 2 = 10$, right? Yes. Bring the one up over the 3, and $3 \times 2 = 7$."

8% Two separate, unrelated problems.

"There's 35 people and 70 cookies. If each one has two cookies each, how could you solve it? If there's 70 kids and 25 more enter, there will be 95 kids in all."

6% Problem situation vague or unclear.

"I went to the store and bought 70 bags of chips and 95 sodas."

29% Other incorrect.

"Mark wanted to buy 2 apples. Both of them costs 35 cents. Then he wants to buy 25 pieces of gum. The gum costs 70 cents for all 25 pieces. ($70 + 25 = 95$. $95 + 70 = 165$)"

"Jane had 70 cookies. Then she bought 25 more. Then she wanted more so she bought 2 more packs of 35 cookies. How many cookies does she have now? ($35 \times 2 = 70$. $70 + 70 = 140$)"

"One day Jill had 35 brouchers. Her mom gave her 2 more. Then she had 70. Then her mom gave her 25 more. How many did she have then?"

4% Blank

Comments

Not surprisingly, a two-step computation presented more difficulty than a simple multiplication. However, the difference in the number of students who succeeded in translating the calculations into everyday problems was not great enough to suggest that the difficulty with such questions lay in the computation itself. It appears more likely that the students who could not answer either question correctly (approximately 40 percent) do not understand the meaning of the calculations that they perform.

The difficulties that students experience with translating word problems into arithmetic procedures have been well documented and are often laid to difficulties in reading comprehension. The results above suggest that different factors may be involved. If children cannot place their arithmetic calculations into some kind of context that is meaningful to them, it should be no surprise that they find difficulty in trying to decipher what the author of the problem intends. In other words, if reading is a process of constructing meaning from the text, as suggested by many educators, it is as important for children to understand the arithmetic concepts as it is for them to understand the verbal ones.

Problems such as the ones above place control in the hands of the students. It gives them the opportunity to think of the effect of operations on numbers and how these operations can be used to order events in their own lives. Asking students to think about numbers in context also helps them to understand the algorithms involved. How does “six more” differ from “six times as many”? The language of mathematics can be difficult for students at this age. By relating mathematical language to everyday events, students become more facile in communicating their ideas mathematically. Finally, this kind of problem offers a good opportunity for group activity as students create and critique possible scenarios in which numerical operations play a part.

ON THEIR OWN

Students' Responses to Open-Ended Questions in Math

Grade 4

This is an oog:



A package of oogs holds six of them. How many packages are needed to hold all the oogs pictured below? (HINT: Use the picture.)

The number of packages needed is _____.



Major Concepts/Abilities Tested

Numeration: concept of division

Ability to model the process of division

The percentage of student responses and appropriate examples are listed under each of the categories below.

Correct Answer/Method

**** 50% 13:** with evidence that student partitioned into groups.

**** 12% 13:** with evidence that student counted and divided.

*** 9% Incorrect answer:** evidence that student partitioned.

- * 7% **Incorrect answer: evidence that student counted and divided.**

8% 13: no work shown.

- ** *good response*
- * *adequate response*

Incorrect Answer/Method

14% **Incorrect answer: no method shown.**

1% **Blank**

Comments

Seventy percent of the students calculated that 13 packages were needed for the oogs drawn in the picture. Although not directed to do so, the majority (59 percent) spontaneously drew circles around groups of six and counted the groups. Most were successful using this method. Those who counted and divided (19 percent) and those who showed no work (21 percent) had more difficulty in calculating the correct answer.

The number of oogs was deliberately large in order to encourage children to order the data in some way. For those who understood the concept of division as a method of grouping, the task was relatively easy. For those who saw it purely in terms of the computation of numbers, it was more tedious and more vulnerable to counting and calculation error.

As with the story problem, this kind of task can be used for both instruction and evaluation. It focuses on the conceptual understanding of computation rather than the algorithm itself and shows a practical application of division as a way of simplifying data.

**Find all the ways you can to fill in
 $\underline{\quad} \times \underline{\quad} = 36$. List all your ways.**

Now draw a picture, sketch, or chart to show one of your ways.

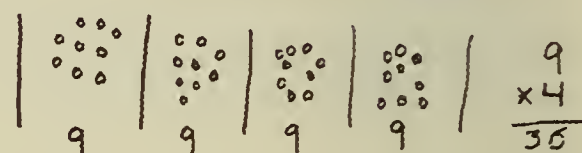
Major Concepts/Abilities Tested

Numeration: recognition of the factors of 36

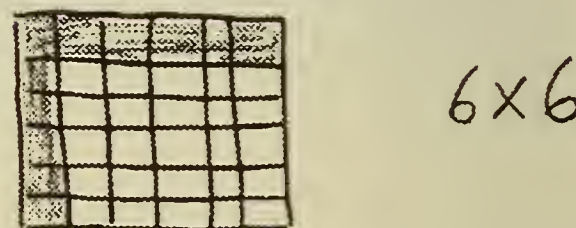
Ability to represent a computation in graphical form

Correct Answers

- ** 57% **Drew accurate and correct representation of multiplication.**



- ** 6% **Drew table, not necessarily filled in.**



Incorrect Answers

13% Draws a representation of the number fact rather than the operation of multiplication.

A hand-drawn representation of the multiplication fact $9 \times 4 = 36$. It shows two groups of objects. The first group consists of 9 vertical, wavy lines. The second group consists of 4 vertical, wavy lines. These two groups are separated by a multiplication symbol (\times). To the right of the multiplication symbol is an equals sign (=) followed by the number 36, which is underlined.

20% Other incorrect answers.

A hand-drawn illustration of a stick figure standing next to a rectangular sign. The sign contains the equation $9 \times 4 = 36$. The stick figure is pointing towards the sign with its right hand.

\times	9
4	36

4% Blank

Comments

This question is essentially the inverse of the first task. Both require an understanding that multiplication and division represent operations performed on groups or collections. Although the two questions appeared in different forms, it should not be surprising that a similar percentage of students answered correctly in both instances.

Forty-two percent of the students could supply only three multiplication number sentences (3×12 ; 4×9 ; and 6×6); while 12 percent gave all nine possible combination of factors. Forty-three percent used the commutative property in listing their combinations. The hurdle for most children was 18×2 and 36×1 as possibilities.

In response to the second question, approximately 60 percent were able to represent multiplication as a number of sets. The remainder of the children did not appear to understand how multiplication could be represented in any concrete form, despite their ability to supply the correct multiplication facts.

Mary, Paula, and George want to share 2 candy bars equally. Show in the drawing below how much candy each person gets. You may use the initials of the children (M, P, G) if you wish.



Now, write a fraction for the portion of candy each child gets: ____.

Correct Answers

**** 27%** $\frac{1}{3}$

*** 18%** $\frac{2}{6}$

Correct Answers/Methods

**** 45%** Shows each candy bar divided into three, equal pieces.



*** 12%** Shows each bar divided into two pieces— $\frac{1}{3}$ and $\frac{2}{3}$.



*** 3%** Other correct answer.



Incorrect Answers

18% $\frac{2}{3}$

9% $\frac{1}{2}$ or equivalent

25% Other incorrect

3% Blank

Comments

This question repeats the theme of the other two—the representation of number operations—in the context of fractions. Despite the greater complexity of the task, the proportion of children who were able to draw an accurate representation remains similar to that found in the whole number problems. Not surprisingly, fewer were able to name the fraction that they had just represented. However, it appears that a necessary condition for success in writing the fraction is the ability to visualize how the candy bar would be divided. Children who could not do this were at loss to understand the computation process involved.

As a whole, the three questions illustrate the importance of representation as a way of understanding what operations actually mean. In the introductory stage of a topic, such as the case of fractions, they provide a context for understanding how “they work.” In the case of familiar topics, such as whole number operations, questions such as these are easy ways to evaluate how well the student actually understands what is being done. Once students become proficient with their “number facts” it is easy to assume that they understand what these facts represent. Questions such as the ones given above are easy ways of checking such assumptions.

Incorrect Answers

5% Divides each bar in half.

4% Candy bars unequally divided.

8% Other incorrect response

22% Blank

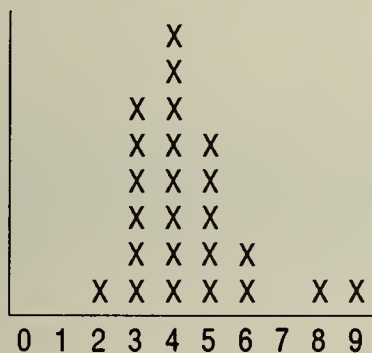
ON THEIR OWN

Students' Responses to Open-Ended Questions in Math

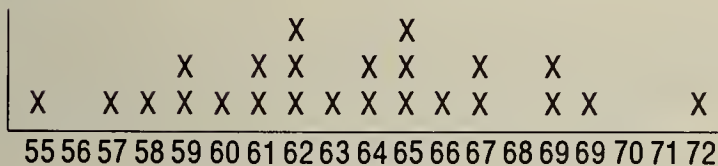
Grade 4

Here are five graphs. They show different things about a class of fourth graders and their families. Look carefully at these graphs to answer each of the three questions below.*

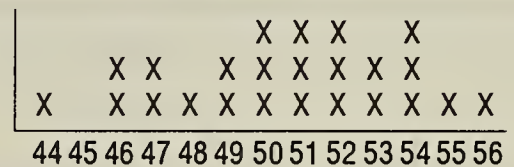
GRAPH A



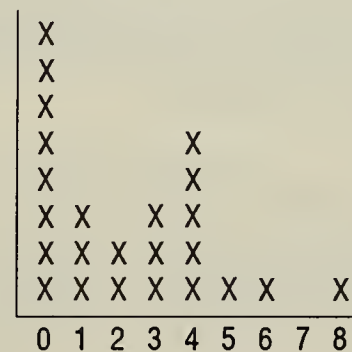
GRAPH B



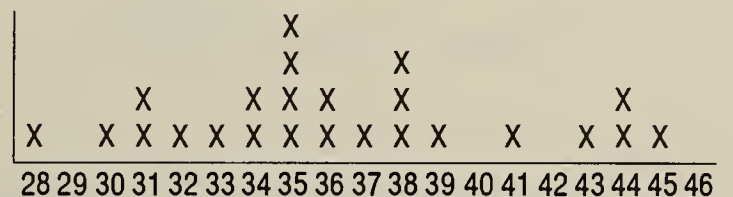
GRAPH C



GRAPH D



GRAPH E



* Adapted from a set of questions developed by TERC (Technical Education Research Center).

Which graph shows the number of cavities that the fourth graders have? ____ Explain why you think so.

Major Concepts/Abilities Tested

Interpretation of graphical data

Reasoning and communication

The percentage of student responses and appropriate examples are listed under each of the categories below.

Correct Answers/Methods

***** 19% Selects D and gives strong supporting argument.**

"Fourth graders wouldn't have that many cavities so therefore it would be a graph with lower numbers. So it couldn't be graph B, D or E. Graph A and D are each small number graphs, but Graph A is a little too large. So it's Graph D."

"Graph D. I think this because most kids my age don't have many because there are new things that keep us from getting them. I know it is not graph A. I don't have any and most of my friends don't."

**** 30% Selects either D or A and gives argument with some merit.**

"Graph D. It has low numbers."

*** 26% Correct graph, but poor or no argument.**

"Graph D. Because each X could stand for one kid who had that many cavities."

******* *very good answer*

****** *good answer*

***** *minimally correct answer*

Incorrect Answers/Methods

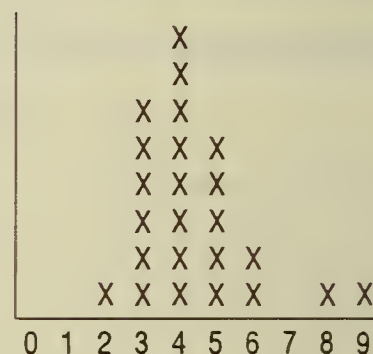
20% Other incorrect response.

"Graph B. I think it is B because a lot of kids eat candy."

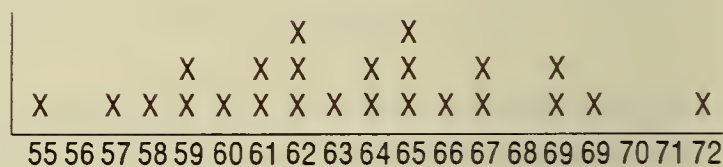
"Graph C. I think this because in graph A, there are too many X's to be cavities. In graph B, the graph is too long. In graph D, there are too many X's, and graph E has the same reason."

3% Blank

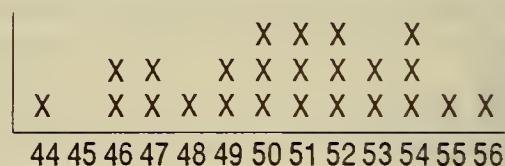
GRAPH A



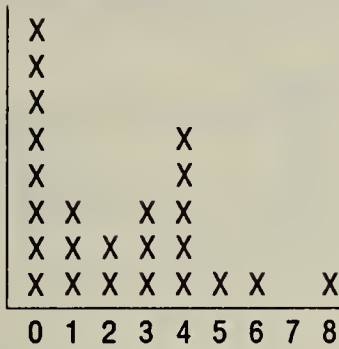
GRAPH B



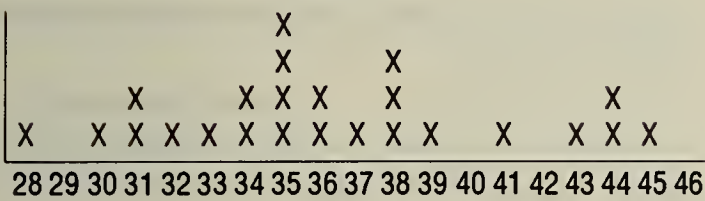
GRAPH C



GRAPH D



GRAPH E



Which graph shows the number of people in the fourth graders' families? ____ Explain why you think so.

Correct Answers/Methods

*** 15% Selects A with strong supporting argument.

"Graph A. It's impossible to have a family of 0. For fourth graders it's impossible to have a family of 1. Also 4 is a balanced number and the most of fourth grade families is at 4."

"Graph A. I chose this because of the following reasons: no one that has a family has 0 family members, no one (except an orphan) has 1 family member, 2 is common for divorced or separated parents, also not many people have 8 family members."

** 28% Selects A or D and gives argument with some merit.

"Graph A. Families are usually made up of 2 to approximately 8 people. The highest number of x's is 8. So my guess is as afore stated."

* 2% Explanation suggests extended families.

"Graph B. Because everybody has to have cousins, aunts, and uncles."

25% Correct graph, but poor or no argument.

"Graph A. Because it has the highest amount of families on the graph."

Incorrect Answers/Methods

24% Incorrect response.

"Graph D. I think the highest number of people in a fourth grade family is 4."

"Graph D because graph A shows the number of cavities in fourth grade."

4% Blank

Which graph shows the heights (in inches) of the fourth graders? ____ Explain why you think so.

Correct Answers/Methods

***** 14% Selects C and gives strong supporting argument.**

"Graph C. I am 48 inches tall which is normal in 4th grade. And Graph C shows 48 inches on it, and no other graph shows that number which is 48."

**** 24% Selects either C, B or E and gives argument with some merit.**

"Graph C. No one would be seventy two inches high. Fifty six is right for most fourth graders."

"Graph C because they're all around the same height."

*** 31% Selects either C, B or E, poor or no argument.**

"Graph B because most fourth graders are tall."

"Graph B. Since we eat better food today I think B would be correct because we are getting much taller."

Incorrect Answers/Methods

23% Other incorrect response.

"Graph E shows different sizes and fourth graders are different sizes."

5% Blank

Comments

The greatest amount of credit was given to those students who indicated that they had read and interpreted the data on each graph before coming to a conclusion. In practice, that meant that they made their argument in terms of evaluation and comparison. Those who received two marks indicated in their response that they had read and understood the graph which they chose. Although their choice was not necessarily correct, it was reasonable. One credit was awarded students who chose the correct graph, but gave a minimal response. It was assumed that they had gone through some process of evaluation, but were unable to verbalize their reasoning.

Undoubtedly, this type of question is unfamiliar to students, and their results reflect this. Less than 20 percent were able to defend their choice of any graph with a strong argument. However, the questions do not represent material that is outside the fourth grade curriculum. Fourth graders often make their own frequency charts of things or events. They are also expected to read graphs and to answer questions about them. What makes this type of question different is the requirement that they apply their general knowledge to a mathematical situation and to ask, "What is reasonable?" Not only is this a productive activity for class or group discussion, but it reinforces the notion that numbers do not exist in a vacuum but represent situations that occur in the actual, everyday world.

ON THEIR OWN

Students' Responses to Open-Ended Questions in Reading

Grade 4

A very short story is going to be broken down into four parts. Read the first part; then answer the question that follows it. Only after you have answered the question that follows one part are you to go on to the next part.

Part 1

The stillness of the morning air was broken. We headed down the bay.

What are some questions you would want to have answered so that you would understand what this story is about?

Major Concepts/Abilities Tested

The ability to recognize the kinds of information needed to construct meaning from the text.

The percentage of student responses and appropriate examples are listed under each of the categories below.

Correct Answers

**** 40%** At least two questions that reflect experience with narratives, e.g., questions about plot, characters, setting, title, genre.

“What happened? Why did you go down to the bay? Was someone screaming? Was there a fire, tornado, or hurricanes?”

“What month is it? What bay are they going to? Why are they going to the bay? Who is we? How was the stillness of the air broken?”

*** 15%** At least one question described above.

*** 10%** Other legitimate questions.

“What does ‘headed down the bay’ mean?”

“How was the morning air broken?”

*** 22%** Some combination of above.

****** *very good response*

***** *adequate response*

Incorrect Answers

5% Irrelevant questions or questions about insignificant details.

“Was the bay pretty?”

7% Other incorrect.

1% Blank

Correct Answers

* 75% Correct inference based on context clues.

“I think that they are fishing and they have caught something big and they really want to see what it is. I think this because of how it says, the net was hard to pull and the good catch encourages us to try harder.”

Comments

The purpose of this set of questions was to model a sequence of questions that might be asked of students as they read a narrative or, preferably, be asked by the students themselves. The passage is taken from one employed by Stephen Norris and Linda Phillips.¹

Reading experts generally agree that reading involves more than decoding the author's meaning. Rather, readers construct their ideas as they progress through the text. This stress on construction of meaning implies activity. The reader must be aware of the kinds of information that she needs and to what extent her own knowledge is relevant to the text. The first question, which asked students to list some questions that would help them better understand the story, attempted to measure students' ability to recognize relevant kinds of information.

Incorrect Answers

14% Correct inference, no reasons given.

10% Incorrect.

1% Blank.

Comments

Can students use contextual clues to construct a general meaning from a text, despite the use of unfamiliar words (e.g., girdie)? The difficulty of a text can be a function of vocabulary, but often there are other factors, such as the complexity of concepts or the structure itself, that account for whether or not students understand the meaning. This question measured students ability to use the context to overcome difficult vocabulary. Approximately three-quarters of the students were able to do this with justification. Those who gave no reasons for their inferences were generally poorer readers. Almost 30 percent of poorer readers (those at the 950 level of proficiency) gave no reasons for their inferences, another 17 percent either copied the story without explanation or continued questions elicited in previous question.

Part 2

The net was hard to pull. The heavy sea and strong tide made it even more difficult for the girdie. The good catch encouraged us to try harder.

What do you think is going on in this story? Why do you think so?

Major Concepts/Abilities Tested

Inferential comprehension

Part 3

Having reached our limit, we were now ready to leave.
The skipper saw a threatening sky to the north.

The people in the story had “reached their limit.”
What does this mean?

Major Concepts/Abilities Tested

Inferring the meaning of phrases from context.

Correct Answers

- * 12% They had caught all the fish they were allowed or the boat would hold.
- * 42% They had enough fish or they were tired of fishing.
- * 7% They had lost their patience.
- * 19% They had gone as far as they would go. (distance)
- * 4% Other reasonable inference.

“In the story, ‘reached their limit’ means their time is up. So they have to leave.”

Incorrect Answers

13% Unreasonable inference.

“They are probably in a airplane and saw a storm to the north. Reached their limit means they are going as high as they can go.”

3% Blank.

Comments

Although a hallmark of good expository writing is its clarity, this is not true of narrative. The meaning that is given to ambiguous phrases can have important consequences to the general interpretation of the text. This question examined how students interpreted one such phrase.

The better readers were more likely to state that “the limit” referred to a legal limit or a physical limit (i.e., the capacity of the boat or a distance). A possible, although less plausible response, was that the fisherman had lost patience. Other interpretations were less convincing, suggesting that the students did not understand the meaning of the phrase.

What did the skipper see in the north? (Use your own words.)

Major Concepts/Abilities Tested

Understanding the meaning of a word from context?

Correct Answers

- * 66% Interprets threatening as stormy, rainy, dark, etc.

Incorrect Answers

12% Interprets threatening as mean, bad, etc.

9% Repeats word “threatening.”

11% Another incorrect response.

2% Blank.

Comments

Although there were several plausible interpretations of the phrase “reached their limit,” “threatening” holds a distinct meaning when it describes the sky, as opposed to a person. While 87 percent of above average readers were able to recognize this distinction, only 64 percent of average readers did so; while about 40 percent of poorer readers made no attempt to define the meaning of the word.

Part 4

We tied up to the wharf. We hastily grabbed our prongs and set to work. The sorting was done by the skipper. The boys did the cutting and gutting.

Why are the skipper and the boys doing what they are doing in this part?

Major Concepts/Abilities Tested

Inferential comprehension

Correct Answers

**** 33% Cleaning or preparing the fish.**

“The skipper and the boys are doing post-fishing activities. The skipper is sorting types of fish catch and the boys are cutting and gutting. That is cutting the fish and taking out the parts you don’t eat.”

*** 15% Doing something because of the approaching storm.**

“A storm was coming their way and they had to get out of there as fast as they could.”

*** 5% Preparing the boat.**

“The skipper and the boys are trying to fix their boat after a rough day at sea. They were also probably cleaning it with hoses.”

Incorrect Answers

11% “It’s their job.”

“Because it is a task they have to do, and so they don’t have to do it later.”

11% Answer repeats wording from the passage.

22% Other incorrect.

“They were trying to build a lifeboat that they were going to row in away from that tornado.”

4% Blank.

Comments

This question followed from the activities in the previous episodes. It is interesting to note that approximately one-quarter of the poorer readers answered “It’s their job.” This response suggests that these students did not understand that the question was asked within the context of the narrative itself and followed from the previous questions.

¹ Norris, Stephan and Linda Phillips. (1987) “Explanations of Reading Comprehension: Schema Theory and Critical Thinking Theory.” *Teachers College Record*. Vol. 89, 2, 281-306.

ON THEIR OWN

Students' Responses to Open-Ended Questions in Reading

Grade 4



EARN FAMOUS NAME

EARN \$1.00 AN ITEM

PRIZES OR CASH

SELL CARDS & GIFTS FROM FREE SALES ALBUM!

GO, GO, GO... WITH CAPTAIN "O"!
PICK YOUR PRIZE from Olympic's FREE full-color Prize Catalog! OR KEEP CASH — \$1.00 for every item sold! It's easy to earn PRIZES or CASH by selling attractive Christmas Cards and Stationery, All Occasion Cards and Gifts from Olympic's FREE 1987 Sales Album!

you pay nothing... owe nothing... return nothing! You get full membership information and all sales material FREE!

SODONTWAIT! Call our Captain "O" operator TOLL FREE now, or mail us your name, address and zip code TODAY!

OLYMPIC SALES CLUB, INC.
Dept. 87EC8 Enfield, CT 06082

100

VCR COLLEGE BOWL GAME Sell 35 Items	SHILCRAFT RADAR BALL Sell 12 Items	UNISONIC "HOT NUMBERS" SOLAR CALCULATOR Sell 8 Items	TURBO RACE SET Sell 20 Items	FRANKLIN MINI-BALL SET Sell 18 Items	VARIFLEX "BREAKER" SKATEBOARD Sell 25 Items	G.E. ONESTEP AM/FM CASSETTE PLAYER Sell 30 Items	SPORTFUNTS SUPER SCOOTER Sell 50 Items	RADIO CONTROL OFF ROAD 4x4 Sell 17 Items
DUAL CASSETTE STEREO RADIO Sell 52 Items	RADIO CONTROL "TURBO LEOPARD" Sell 32 Items	G.E. AM/FM LED DIGITAL CLOCK RADIO Sell 18 Items	TYPE-RIGHT TYPING TUTOR Sell 32 Items	MUSICAL "MY JEWELRY" CHEST Sell 18 Items	STEMMLER GLASS BOW ARCHERY SET Sell 18 Items	PARKER BROS. NERFOOP INDOOR BASKETBALL Sell 8 Items	COX P-51 MUSTANG Sell 21 Items	G.E. STEREO AM/FM CASSETTE HEADSET PLAYER Sell 23 Items
SPALDING PRO SUPERSTAR BASKETBALL Sell 16 Items	REMOTE CONTROL REMO-BOT Sell 9 Items	SENIOR CHEMISTRY LAB Sell 20 Items	E.K.O. THE ECHO PET Sell 30 Items	WHEEL OF FORTUNE GAME Sell 12 Items	SCHOLASTIC BEST SELLERS BOOK SET Sell 8 Items	SNO-SURF TUBE Sell 10 Items	SPALDING MSL SOCCER BALL Sell 12 Items	
		LORUS CHRONO-ALARM WATCH Sell 11 Items						



PHONE FREE

ASK FOR SUSAN...

She or another Captain "O" operator is waiting to rush your name, address and zip code to us.

* PLEASE... operators can take name and address only... CANNOT answer questions. (Service available in 48 United States and Puerto Rico, Alaska and Hawaii reply by mail.)

1-800-528-6644

Massachusetts Department of Education

April 1991

Massachusetts
Educational
Assessment
Program

In the spring of 1990 over 9,000 fourth, eighth, and twelfth grade students were assessed using open-ended mathematical, scientific, social studies, and reading concepts. This series of reports describes and discusses the results of these assessments. Prepared by Elizabeth Badger and Brenda Thomas.

Explain in your own words all the things you have to do to get prizes or cash.

Major Concepts/Abilities Tested

Reading for detail

Drawing inferences

Correct Answers

***** 22%** Answer communicates the basic idea that you earn cash or prizes by selling items and refers to procedure for doing this.

"Call Susan for a catalogue. Then you have to sell items. You can get different prizes depending on how many items you sell. You can get cash because if you want you can have a dollar for every item sold."

**** 40%** Answer generally correct, but is vague concerning procedure.

"You get prizes or cash if you sell a number of items from their company. Example: I sold 30 items, I get a boom box."

*** 7%** As above, but misinterprets or oversimplifies terms of the offer.

"You sell cards, gifts and stationary, and then you can either keep the cash or send it in for prizes."

******* *complete response*

****** *adequate response*

***** *minimal response*

Incorrect Answers

8% Answer misinterprets advertisement.

"You can sell items, gamble, try to win on a TV. game show. You can also save up money you earn to buy gifts."

"Call 1-800-528-6644 and ask for Susan. She'll give you details. Then pick your prize or money and mail name and zip-code."

15% Answer depends on inappropriate use of prior knowledge rather than reading the text.

"If you want cash or prizes you have to enter a contest or suppose you are the one millionth customer in a store, you could win prizes or cash ... You could also raffle things off by writing the amount of cash or prizes on a piece of paper and there're numbers on everybodys piece of paper that they have and whoever get the number gets the prize or amount of money."

7% Other incorrect.

"You have to sell 35 books, 50 candybars, and 5 baby kittens and then call 1-800-538-6644 and ask for Susan and tell her you've sold everything."

2% Blank

Comments

Whether we desire it or not, advertising forms an important influence on all our lives. The stimulus for this question was an actual advertisement that appeared in a children's magazine. The question itself investigated how well the students were able to infer the terms of the offer and to identify the procedure required. This was not an easy assignment. The layout was cluttered and deceptive, the prose had to be read carefully for details, and large inferences had to be made. The "cash reward" led many students to believe that they could keep all the cash from their sales. Others did not realize that "free" referred only to the sales catalogue, not to the items themselves. The terms of the offer (selling cards and gifts) were carefully couched in enticing prose dwelling on the ease with which cards could be sold. Alternately, the requirements could be inferred from the descriptions under the picture of each "prize." All in all, this was a realistic test of students' ability to sort out the facts from a set of half-truths and deceptive prose.

Advertisements use many ways to convince people to do something. What are some ways that this advertisement tries to convince you? Give examples from the advertisement.

Major Abilities Tested

Relating information to prior knowledge

Applying critical evaluation

Correct Answers

***** 22% Answer refers to at least three correct persuasive techniques.**

"This advertisement tries in one way to convince you by enlarging the good things you get. Another way is by not giving that much information about the things you have to do. They write words that make kids want to try to win the prizes and cash. They make it sound very easy and fun."

"They say you pay nothing, owe nothing, return nothing, but you have to sell things. They also say you get everything free, but you still have to sell something. They show picture of great prizes but they're probably cheap!"

**** 24% Answer gives examples from advertisement but does not explain their use.**

"The advertisement says you get everything free, even the phone call is free! Earn one dollar for every item sold!"

"Earn famous name! Pick your own prizes! or take cash! You pay nothing, owe nothing, and return nothing!"

"All you have to do is sell gifts and cards and you get free prizes. And the phone call is free and you get \$1.00 per card or gift you sell."

"They show prizes that make you want to sell stuff. And they show happy children. That makes you want to sell and look happy too."

- * **27% Answer refers to a single technique or gives a general response. Some lack of understanding.**

"The ad tries to convince you by showing you all the things you could win."

"They convince you that you will get money and prizes if you sell something but you might not."

- *** *complete response*
- ** *adequate response*
- * *minimal response*

Incorrect Answers

- 4% Answer misinterprets advertisement.**

"They tell all the good things about the item. They put famous people on TV. trying to sell an item to you and a lot of other things too."

- 9% Answer refers to unrelated knowledge or gives general discussion of advertising.**

"Suppose you listen to the radio say something about hair tonic and they convince by giving people money just to see it work, just for people to buy their products. But when you try, it does something wrong instead of something good. And they also give you commurcules

on body oil, but when you try it yourself your body gets kind of pale, and you can't take it off."

- 12% Other incorrect response.**

"With Olympic you pay nothing, owe nothing, return nothing."

- 2% Blank**

Comments

In response to this question, students were asked to assume a critical stance. Assuming that they had all had some experience with advertising techniques, they were asked to identify their specific use in the advertisement. This allowed them to step outside the text itself and to judge the way in which the author uses words and pictures to convince the reader. This question calls for a recognition of the emotive power of words to persuade and confuse. Although most students were able to recognize examples of one or more specific techniques that were used in the text, only a few were able to characterize those techniques and describe their effect.

ON THEIR OWN

Students' Responses to Open-Ended Questions in Reading

Grade 4

One Day When We Went Walking

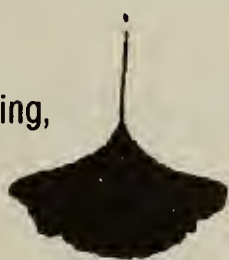
One day when we went walking,
I found a dragon's tooth,
A dreadful dragon's tooth.
"A locust thorn," said Ruth.

One day when we went walking,
I found a brownie's shoe,
A brownie's button shoe.
"A dry pea pod," said Sue.

One day when we went walking,
I found a mermaid's fan,
A merry mermaid's fan.
"A scallop shell," said Dan.

One day when we went walking,
I found a fairy's dress,
A fairy's flannel dress.
"A mullein leaf," said Bess.

Next time that I go walking—
Unless I meet an elf,
A funny, friendly elf—
I'm going by myself!



Major Concepts/Abilities Tested

Inferential comprehension

The percentage of student responses and appropriate examples are listed under each of the categories below.

When the poet found a mermaid's fan, why did Dan say, "A scallop shell"?

Correct Answers

**** 17%** Response indicates an understanding of the underlying theme of the poem by making explicit reference to Dan's lack of imagination in contrast to that of the speaker (poet).

"The poet has a good imagination, but Dan is looking for a more real explanation. Dan is more of a person who is the type that thinks that there is a reasonable explanation for everything."

Massachusetts Department of Education

April 1991

Massachusetts
Educational
Assessment
Program

In the spring of 1990 over 9,000 fourth, eighth, and twelfth grade students were assessed using open-ended mathematical, scientific, social studies, and reading concepts. This series of reports describes and discusses the results of these assessments. Prepared by Elizabeth Badger and Brenda Thomas.

"The poet was creative, and liked thinking that one thing was like something else. But Dan didn't have a creative mind. He just thinks of things just like they are."

"Because the poet wanted to make the walk more imaginative."

- * **32% Response concentrates on the objects themselves but does not connect this to the larger issue of the difference between the viewers.**

"Dan said a scallop shell because even though it looks like a mermaid's fan it isn't. It's just a scallop shell and mermaids aren't real."

"Dan said, 'a scallop shell' because it wasn't a mermaid's fan, it was a scallop shell."

- ** *Full and complete response*
- * *Adequate response*

Incorrect Answers

- 41% Response indicates a very literal interpretation.**

"Because a scallop shell is shaped like a mermaid's fan and it also looks like any other fan."

"Dan said, 'A scallop shell' because that was what it looked like."

"Dan said a scallop shell because a mermaids fan would look like a scallop shell."

- 8% Other incorrect.**

"Dan said, 'a scallop shell' because a mermaid probably uses a scallop shell for a fan."

- 1% Blank**

Comments

The power of this poem depends upon understanding the contrast between two visions of the world: the fanciful, associative style of the poet as opposed to the realistic, objective style of the other characters. The first three stanzas set the scene, using the same structure, varying only in the details. In the last stanza the tense changes from past to future, and the mood changes from wistful to emphatic. However, without realizing the contrast in vision that is built up in the first stanzas, the point of the poem makes little sense.

Only a relatively small proportion of the students were able to express the general theme of the poem, i.e., the contrast between the imaginative and realistic perceptions of the characters. The majority of correct responses answered in more concrete and specific terms, referring to the objects themselves. Half the students either did not understand the poem or were unable to express their understanding.

If Ruth and Sue were walking together, what do you think their walk would be like?

Major Concepts/Abilities Tested

Ability to predict actions or reactions of the characters

Correct Answers

- ** 13% Response describes the more prosaic approach of Ruth and Sue and gives a reason why.**

“Boring, because they don’t have a good imagination.”

“They would probably get along very well. Sue doesn’t have a very good imagination, neither does Ruth, so the walk would be very real, and it wouldn’t be as exciting.”

“They wouldn’t have a good time because they don’t have much of an imagination.”

- * 13% Answer as above but doesn’t explain why.**

“If Ruth and Sue went walking together their walk would probably be more realistic than their walk with the poet.”

“If Ruth and Sue went walking together the whole walk would be true.”

Incorrect Answers

- 8% “Argumentative,” etc. based on the responses of Ruth and Sue to the poet (speaker).**

“They would have a hard time because they would not agree with nothing.”

“They might find different things and maybe argue over what it was and agree.”

- 8% “Interesting,” based on the items mentioned in the poem.**

“Great because when they go walking they’ll find lots of things.”

“It would be like a treasure hunt because they would find weird things.”

- 8% “Interesting,” based on a misconception of their personalities.**

“I think if Ruth and Sue went walking together their walks would be very imaginative.”

- 20% “Interesting,” “funny,” “scary,” with no support.**

“It would be a very strange and spooky walk!”

“I think it would be funny because they’d talk about what they thought things were.”

- 8% Answer misses point and refers to details in stanzas 1 and 2 as support.**

“It would be a very weird one because one has a dragons tooth and the other has a brownies shoe.”

“If Ruth and Sue went walking, Ruth would look for things that look like dragons body parts. And Sue would look for a brownies shoe.”

19% Other incorrect.

“They wouldn’t have found as many things.”

“Their walk would be like a road to a fairy tail.”

2% Blank

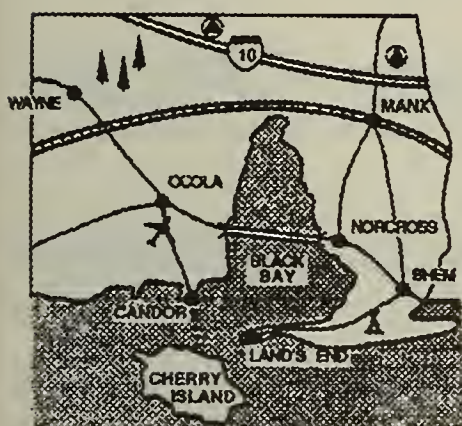
Comment

This question again investigated students’ ability to understand the underlying theme of the poem by asking the students for a prediction. Most students found this to be a more difficult task. Not only were they required to understand the major theme of the poem, they had to interpret the characters of Sue and Ruth, and to project how they might interact with one another. Their responses clearly showed that students did not recognize the author’s overall intent, but were distracted by the wealth of objects that were contrasted in the poem.

ON THEIR OWN

Students' Responses to Open-Ended Questions in Social Studies

Grade 4



You and your family live on Cherry Island. (See the map above.) Some friends are coming for a visit. They will be travelling east on Route 10. Write a set of directions telling your friends how to get to Cherry Island.

Major Concepts/Abilities Tested

Process skills

Map skills including ability to read and use maps

Ability to organize information

The percentage of student responses and appropriate examples are listed under each of the categories below.

Correct Answers

**** 13% Correct route including all stages using cardinal directions.**

“Go south past Manx. Go southwest to Norcross. Go west past Black Bay. Go south to Candor to take a boat across.”

(Although this response appears brief, it covers each stage adequately and correctly.)

**** 12% Correct route including all stages using left/right directions.**

“Go down route 10 until you meet a four-way with a rest area, take a right. Follow that road until you reach a railroad track that goes through the town of Manx. Take the right hand road. Follow that road until

you find another town, go right across the bridge, keep going straight until there's a three-way, go left all the way down that road to a ferry. Take the ferry to us."

*** 6% Generally correct route—confuses cardinal or left/right directions.**

"First you will pass the State Forest (on your left). Then a little before a rest area, go down to Manx until you come down to a railroad. Now there is a fork in the road. You will take a left one now you come to a bridge. Go over the bridge, you see an airport. One your side of the airport, go down that road. Now you are at a ferry. Go down the ferry and you car here."

(This student confused left and right but otherwise answered correctly.)

*** 27% Generally correct route—one or two stages confused, incorrect or missing.**

"To go to my house travel up route 10. When you see a road on your right, turn right and then you will end up in Manx. Keep going down the road that you did on route 10. You'll end up in Norcross. Go over the bridge. Keep on going. You will see a road going south. Go down it to the Ferry, that will take you to Cherry Island."

(This response does not mention that the road forks in Norcross.)

**** good answer**

*** minimally correct answer**

15% Directions based on inaccessible routes or transportation other than car or ferry.

"As you are traveling east on route 10, stop at the rest area. Then start south and you should come across a railroad. Take a train west then south until you reach Ocola. Take a plane south until you reach Candor. Finally take a ferry to Cherry Island."

15% Other incorrect response.

"Start at Shem. Go straight. Go over the bridge. Keep on going then take a left. Go straight again."

4% Blank

Comments

Over half the students were able to meet the requirements of this question with some success, but half of those missed a step or confused directions. This question measured two separate skills: the first is the ability to comprehend and interpret a map correctly; the second is the ability to articulate the process and present it clearly and logically. Most fourth graders are accustomed to finding something on a map, but far fewer are able to describe the correct way of getting there. This requires that students organize the material in a logical manner and present it with the appropriate details to make it recognizable. The need for this type of writing crosses all other subject areas, especially science and math, where clearly articulated sets of procedures are necessary for duplication of results.

Probably most fourth graders could point out Cherry Island on the map, but we see that they have some difficulty in describing how to get from one place to another. This type of question illustrates the need to do rather than hear this type of social studies.

Incorrect Answers

8% Gives directions (cardinal or left/right with little or no reference points indicated.

"1. When you come to a rest area, stop and turn right. 2. When you turn, keep going straight until you come to the bridge. 3. When you cross the bridge turn left and go straight. 4. When you come to the ferry, take it across to Cherry Island."

ON THEIR OWN

Students' Responses to Open-Ended Questions in Social Studies

Grade 4



The picture above shows children living in the early American colonies. How were the day-to-day lives of these children like your life? (Discuss many ways that they were probably the same.)

Major Concepts/Abilities Tested

Sense of history

Relationship with the past

Specifics of colonial life

The percentage of student responses and appropriate examples are listed under each of the categories below.

Correct Responses

- *** 11% Evidence of abstract concept(s) i.e., makes generalizations about human nature; discuss “big ideas” with or without comparative statements; commonalities within cultures (work ethic, love, human needs); technology vs. environment.**

“Both now and then we have arithmetic and reading. We also have a teacher. Also, like then, there is always a genius in the class and there’s always someone everyone picks on. Then and now we use the alphabet.”

(Initially this response seems to be a list of what similarities are made in the school, but the student jumps from the simple components of a classroom to a much larger issue—one of human nature. The student recognizes something essentially human about the condition of being the genius or being the goat in a classroom.)

- ** 21% Literal, more concrete response—includes two or more comparative statements and elaborates beyond specifics in the picture.**

“We both live in homes. We both go to school. We both are humans. We both are boys. We have teachers.”

(This response also recognizes the human condition, but that recognition seems a physical rather than an emotional or spiritual connection.)

- * 39% List of a range of similar items rather than comparative statements.**

“They went to school. They had clothes. They ate everyday. They did chores. They lived in houses.”

- * 23% List of similar items based predominantly on the picture.**

“They sit in chairs like we do. They learn the alpha-

bet like we do. They braid there hair or put them in pony tails like we do.”

- ***** *very good response*
****** *good response*
***** *minimally correct response*

Incorrect Responses

- 3% Limited response i.e., only one similar item or comparison given.**

“Their life in the early American colonies wasn’t much alike, but we had to go to school.”

- 2% Incorrect/inaccurate response only.**

“No desk, no T.V., no books, no chalkboards, no erasers, no clocks, no lights, no crayons, no sinks, no coat closets.”

- 1% Blank**

Comments

In the elementary grades the study of history should develop in students a sense of the significance of the past and a unity with those whose lives they study. By the fourth grade, students seem to have developed a sense of similarities and universalities between then and now. The task is to instill a sense of importance to the details that they recognize. Is the fact that they also use chairs an important bridge in the chronological gap? Students can begin to assign values to the details they note. By making history real, students can begin to appreciate the significance of the past on the present. That 94% of the students were able to note some similarities indicates that students are on their way to achieving this understanding.

How were the day-to-day lives of these children different from yours? (Discuss many ways that they were probably different.)

Major Concepts/Abilities Tested

Sense of history

Relationship with the past

Specifics of colonial life

Correct Responses

- *** 5% Evidence of abstract concept(s) i.e., makes generalizations about human nature; discuss “big ideas” with or without comparative statements; commonalities within cultures (work ethic, love, human needs); technology vs. environment.**

“We have lunch and recess. We get to watch videocassettes. We have other activities such as art, music, gym, media, and some advanced classes. We have a lot of new technology. They didn’t have those things, but they had some things that we don’t have such as: rich soil, good farming, different clothes, and more and more nature and natural resources.”

- ** 23% Literal, more concrete response—includes two or more comparative statements and elaborates beyond specifics in the picture.**

“Some of the ways we’re different were their houses are colder than ours. We have machines to do most of our work. We have flowing water and electricity. We have bigger schools and telephones.”

- * 44% List of a range of different items rather than comparative statements.**

“I have ridden in a car and plane. I have a desk. I have a TV. I have a microwave. I have a radio. I have a nintendo. I have electricity.”

(Although the student implies that the colonial students have not done what he has, there is no elaboration of this. If the student had stated, “I’ve ridden in a plane, and the colonial student probably walks or goes places in a horse drawn wagon,” then this statement would have been considered in the second category of responses.)

- * 24% List of different items based predominantly on the picture.**

“They are wearing some clothes that we don’t. The boys have to wear bows in the back of their tails, but us boys don’t. The schools in the early American colonies are more different than the schools we have now. They dress up like pilgrims.”

“They wrote on slates instead of on paper. They sat on wooden benches instead of metal chairs. They didn’t have desks like we do.”

- ***** *very good response*
****** *good response*
***** *minimally correct response*

Incorrect Responses

- 3% Limited response i.e., only one different item or comparison given.**

“They wore different clothes and the men wore wigs.”

1% Incorrect/inaccurate response only.

“We go to a school not a house and we don’t wear uniforms.”

“They stay home and go to school.”

0% Blank

Comments

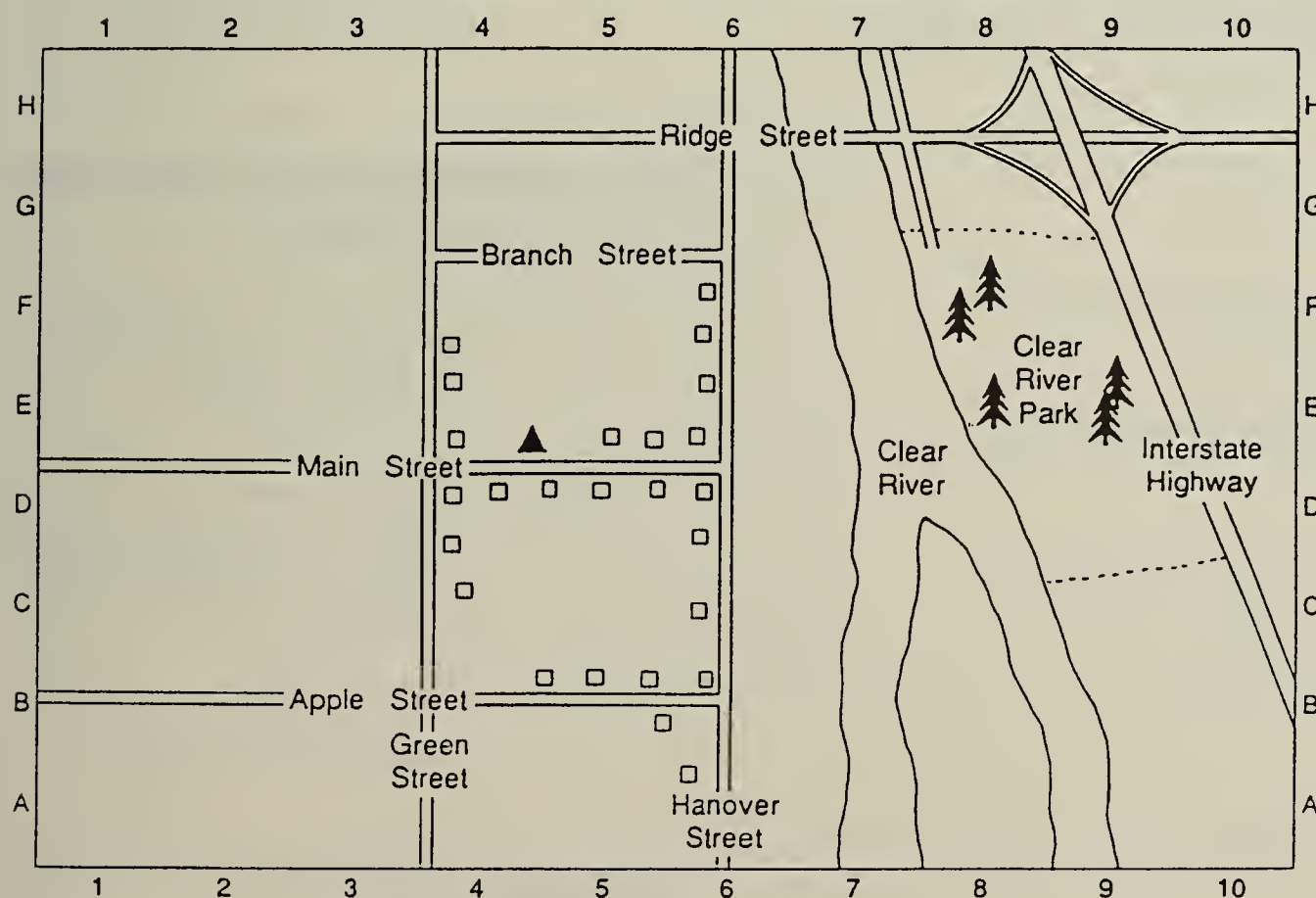
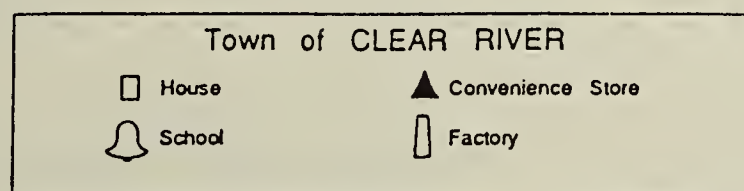
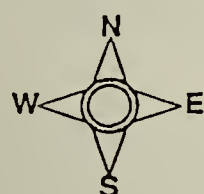
Students performed extremely well on this question with 96% of the students able to provide at least an adequate response. As in their selection of similarities, students, by their choice of differences, are indicating what they feel is important. Those differences students noted (mainly technological) signify vast differences in our culture and how we live. Students appear to be able to note and appreciate these differences while maintaining a unity with the past.



These two questions direct students to make connections between their own worlds (starting with the classroom and expanding outward) and those of the past. By asking what is the same and what is different, teachers begin to encourage a habit of mind that enhances understanding of today’s world.

ON THEIR OWN

Students' Responses to Open-Ended Questions in Social Studies

Grade 4



A school and a factory are going to be built in Clear River. Where do you think the best locations for these would be? Draw a bell  on the map where you think the school should be. Draw a smokestack  on the map where you think the factory should be. In the proper places on the next page, give the map coordinates of the school and the factory, and explain why you think the locations you chose are the best locations.

Major Concepts/Abilities Tested

Process skills

Map skills

Human geography

Graphic representations

Part 1—Placement on Map

School / Factory

* 90% 90% Accurate placement on the map

4% 4% Inaccurate placement in river

2% 1% Other inaccurate placement

3% 3% Blank

* *correct answer*

(Any placement in the street, park or median of the highway was considered inaccurate.)

Part 2—Give Coordinates

Correct Answers

School / Factory

** 55% 57% Correct coordinates using letter and number

** 3% 2% Correct coordinates using other description for example, the corner of Green and Apple Streets

* 10% 9% Partial correct coordinate (letter only, number only or partial description)

Incorrect Answers

3% 3% Coordinates mismatched to placement on map

4% 4% Evidence of misunderstanding of term "coordinates" (used as a verb)

6% 6% Other incorrect response

19% 19% Blank

** *good answer*

* *minimally correct answer*

Part 3—Explanation of Selected Site

Correct Answers

School / Factory

***** 14% 16%** Two or more acceptable reasons with elaborations or one reason with two acceptable explanations

“I put the school on Branch Street because I thought that there is a nice big spot to play in and it is near most of the houses so kids won’t have far to walk.”

“E-1 is pretty far from Clear River and Clear River Park. The factory would not pollute it very much. Also, the workers wouldn’t have too far to drive.”

(Reason and explanation may seem redundant, but the explanation is an elaboration of the reason. In other words, in the first example, the reason the school was placed on Branch Street is that it has a “nice big spot” and the explanation for that reason is “for kids to play in.” In the second example, there is one reason, the factory would be far from Clear River (meaning the river and not the town) and Clear River Park, the explanations are that the river and park wouldn’t get polluted and the workers would have far to drive. The factory was situated in coordinates E-1.)

**** 52% 52%** One acceptable reason with one acceptable explanation

“I think that’s the best place for the school because it’s near the houses and people will not have to go too far to get to school.”

“I put the school there because there are a lot of houses and they have to walk far and that will say all their energy and plus if you forget your homework you don’t have to walk so far back.”

(Although this student has three explanations why the school was placed near the homes, the three explanations are really the same that is that students would not have so far to walk.)

**** 8% 7%** Two or more acceptable reasons without explanations or explanations without reasons

“School—It is close to the houses and there is a large area.”

*** 17% 16%** One acceptable reason without explanation or explanation without reason

“I put it there because it is close to Clear River Park.”

(Here there is a reason for placing it but there is no explanation as to what being “close to Clear River Park” means.)

- ***** very good response
- **** acceptable response
- *** minimally acceptable response

Incorrect Answers

School / Factory

5% 9% No acceptable reasons or explanations or other incorrect answer

“The school coordinates a library for people to take books out or for people who have a hard time working so they can do research.”

“The factory coordinates a cleaning product so it will be easy for people to clean things and the people who need the product will shop at the factory.”

(Obviously the student who gave the above responses misunderstood the meaning of the word coordinates and that misunderstanding influenced the rest of the answer. Four percent of the students answered in this manner.)

3% 0% Blank

Part 4—Environmental Issues

School / Factory

4% 49% Evidence that pollution/ environmental issues were considered in selection of site

94% 51% No evidence that pollution/ environmental issues were considered in the selection of site

(Environmental concerns were noted but not scored as correct or incorrect.)

Comments

Generally fourth graders do not leave questions unanswered. That 19% of the students left the coordinates portion of this question blank indicates a possible problem with the vocabulary or a mismatch with fourth grade curriculum. Since this question was a part of the larger question, it may be that students felt more comfortable with leaving a portion of the question blank.

This question focuses not only on the process skills involved with map reading and interpretation of visual data, but also on the concept of community. In order to answer the explanation portion of the question, students had to consider the community and its needs, whether economic, social or environmental. They had to analyze the human interaction with the environment in order to reason why they placed something where they did. This concept of community can be enlarged to the idea of global community. The world has been made smaller through electronics, and students are aware of events taking place across the globe. At this point, they can start making the connections that tie us to the rest of the world.

